Appendix J

Base Layer Decoder Specification

DemoGraFX MPEG-2 Base Layer Advanced Television Specification

General:

Pixel Aspect Ratio: Square Pixel Spacing Only

Interlace: Interlace Prohibited (unless synthesized in the decoder for NTSC backward compatibility only, and must then be combined with Zooming)

Decoder:

Decoder Rate : Up To 18.88 MPixels/Second, I and P frames

Temporal Enhancement To Base Layer: Additional 18.88 MPixels/Second, B Frames

Frame rates: 24.0 Hz and 36.0 Hz

Temporal Enhancement Frame Rate: 72.0 Hz

FIFO Input Buffer Minimum Size: 1mbit
(note: larger input buffer sizes are only useful for receivers which support optional enhancement layers)

B Frame Restriction : B Frames Only Available In Temporal Enhancement Layer,
No B Frames Allowed In Temporal Base Layer Decoder

Decoder Color Resolution: 1/2 resolution for U, and V in both X, and Y
(this is sometimes known incorrectly as 4:2:0 encoding)

Decoder Horizontal Resolution: 1024

Decoder Vertical Resolution: 512

Required Decoder Buffers: Two buffers are used for P and I frame decoding and prediction

Decoder Buffer Size: Each decoder buffer is 1/2 MPixel at 3/2 byte per pixel

Decoder Memory: 1.5 MByte
(3/2 byte per pixel, times two buffers, times 1/2 MPixel, or 1.5 MByte)

Temporal Enhancement Memory: 0.75 MByte additional
(3/2 byte per pixel, times one additional buffer, times 1/2 MPixel, or 0.75 MByte)

Total, When Base Layer Temporal Enhancement Is Present 2.25 MBytes

(1.5 MByte + 0.75 MByte)

Nearest Macroblock Resolution: All picture resolutions fill 16x16 macroblocks.
No partially-filled macroblocks are supported in the decoder.

Colorimetry: Specified in Universal Header System
Video Color and Film Color Primaries Both Required

Dynamic Range and Transfer Function: Specified in Header System
Video Curve and Logarithmic/Density Film Curve Both Required

Display:

Display Minimum Horizontal Resolution: 640

Display Maximum Horizontal Resolution: up to 1024 (optional)

Display Minimum Vertical Resolution: 480

Display Maximum Vertical Resolution: up to 512 (optional)

Overlay Plane Minimum: 8

Overlay Plane Maximum: 24

Display Devices Requiring Buffering:

Display Frame Rate Restriction: 72.0 Hz

Display Exception: A special mode for backward-compatibility for NTSC conversion is allowed, re-interlacing and drop-frame to achieve 59.94 Hz interlaced NTSC. A 2x zooming option must be provided for this mode to provide legibility of text, since text would not be filtered for interlace. The 24 Hz source is treated with 3-2 pulldown for existing NTSC televisions. The 36 Hz mode is treated with 2-1-2 pulldown.

Display Buffering: The display memory is double buffered

Display Buffering Exception: For special backward compatibility with NTSC, triple buffering is required.

Display Buffer Size: Display buffer size is determined by the format (e.g. RGB vs YUV), the display resolution (minimum 640 x 480, maximum 1024 x 512), and the two buffer requirement. In addition, 1 to 3 bytes per pixel are required for the overlay plane memory.

Optimal Quality Base Layer Display:

Horizontal: 1024
Vertical: 512

Two buffers of RGB, for a total of 6 Bytes/Pixel

Total Base Layer RGB Double-Buffer Memory: 3,145,728 Bytes (3MBytes)

16 Bits Overlay Plane

Total Overlay Plane Memory: 1,048,576 Bytes (1MByte)

Total Display Memory: 4,194,304 Bytes (4MBytes)

Display Devices Not Requiring Buffering:

Some display devices do not require buffering. One example is the active matrix liquid crystal (some versions). For such devices which do not require buffering, the display will be updated at the decoded image update rate (either 24 or 36 Hz). No additional buffers would be needed for such devices, with the exception of overlay plane memory, which requires 1 to 3 bytes per pixel.

General Display Issues:

Pan-And-Scan: When sending images which are wider than 1.33 : 1, information must be present in the MPEG-2 transport stream to specify the composition of pan-and-scan on the wide-screen images. Such pan-and-scan would represent the (usually 640 x 480 resolution) position within the 1024 x 512 decoder memory template. This information is specified to the nearest 1/16 Pixel using the MPEG-2 fields:

frame_centre_horizontal_offset — This is a 16-bit signed integer giving the horizontal offset in units of 1/16th sample. A positive value shall indicate that the centre of the reconstructed frame lies to the right of the centre of the display rectangle.

frame_centre_vertical_offset — This is a 16-bit signed integer giving the vertical offset in units of 1/16th sample. A positive value shall indicate that the centre of the reconstructed frame lies below the centre of the display rectangle.

Pixel Re-Sizing: Pixel Re-Sizing Not Required In The Reference Decoder (except for the NTSC backward-compatibility mode, which requires zooming by 2)

Recommended Practice For Full-Screen Format Resolutions:

The following resolutions would be utilized by the program originator or program master to fill the screen for each of various aspect ratios:

Aspect Ratio	Horiz.	Vert.	
1.33 : 1	640	480	
1.37 : 1	704	512	
1.67 : 1	800	480	
1.80 : 1 (replaces 16:9)	864	480	(6/5 horizontal expansion of squeezed 720 16:9)
1.85 : 1	944	512	
2.00 : 1	1024	512	
2.37 : 1	1024	432	

All formats have square pixel spacing. The formats all have horizontal and vertical resolutions which are a multiple of 16, so that optimum macroblock utilization is provided in the decoder. The decoder will have 1/2 Megapixel, capable of decoding 1024 x 512. All formats are contained within a 1024 x 512 template, so that no vertical resolution exceeds 512 and no horizontal resolution exceeds 1024. The aspect ratios at 480 lines can be adjusted to allow use of the full 512 height by widening or narrowing the screen width and aspect ratio to the nearest 16-pixel-wide macroblock as follows:

Aspect Ratio	Nearby	Horiz.	Vert.
1.31 : 1	below 1.33 : 1	672	512
1.34 : 1	above 1.33 : 1	688	512
1.656 : 1	below 1.66 : 1	848	512
1.688 : 1	above 1.66 : 1	864	512
1.75 : 1	below 1.77 : 1	896	512
1.78 : 1	above 1.77 : 1	912	512

Appendix K

Temporal and/or Resolution Enhancement Layer Specifications

DemoGraFX MPEG-2 Enhancement Layer

General:

Pixel Aspect Ratio: Square Pixel Spacing, Except Resolution Enhancement Mode 2

Interlace: Interlace Prohibited

Display Frame Rate Restriction: 72.0 Hz Only
(except temporal base layer Active Matrix or DMD flicker-free displays directly operating at both 24.0 and 36.0 Hz only, and temporal enhancement devices at 24.0, 36.0, and 72.0 Hz only)

Three Options Of Enhancement:

1. Temporal Enhancement At Base Layer Resolution (see base layer)
2. Resolution Enhancement Without Temporal Enhancement
3. Resolution Enhancement With Temporal Enhancement

Four Resolution Enhancement Modes:

1. At 36 and 72 fps, 1632 x 816 Within 2048 x 1024
2. At 36, and 72 fps, 1344 x 992, Stretched 3/2 Horiz. Within 2048 x 1024
3. At 24 fps, 1984 x 992 Within 2048 x 1024
4. At 24, 36, and 72 fps, 1536 x 768 Enhancement
   on 3/2 Expanded Base Layer, Yielding 1536 x 768

Two Enhanced Display Resolutions:

1. 2048 x 1024, Scaled Only In Mode 4 by 4/3 From 1536 x 768
   Overlay Plane Of 16 Bits
2. 1536 x 768, Scaled Down In Modes 1-3 by 3/4 From 2048 x 1024
   Overlay Plane Of 8 Bits

Decoder:

Decoder Enhancement Type :
Base Layer Temporal Enhancement (optimized for medium-resolution sports):
Up To 18.88 additional MPixels/Second, using B frames(up to 37.7 total w/base)

Resolution (HDTV) Enhancement w/o Temporal (optimized for movies):
Up To 45.1 MPixels/Second , I and P frames only (up to 64.0 total w/base)

Temporal Enhancement to High Resolution (HDTV) Layer (optimized for high resolution sports and movies):
Up To 45.1 additional MPixels/Second, using B frames(up to 128.0 total all layers)

FIFO Input Buffer Minimum Size:
Base Layer Temporal Enhancement: 1mbit (2 mbits total, with base)
Resolution Enhancement w/o Temporal: 2mbits (3 mbits total, with base)
Resolution Enhancement with Temporal: 4mbits (6mbits total, with base)

Resolution Enhancement Parameters:

Decoder Color Resolution: 1/2 resolution for U, and V in both X, and Y
(this is sometimes known incorrectly as 4:2:0 encoding)

Resolution Enhancement Mode Change:
Enhancement Mode May Optionally Change At Every "I" Frame

Resolution Enhancement Mode 1:

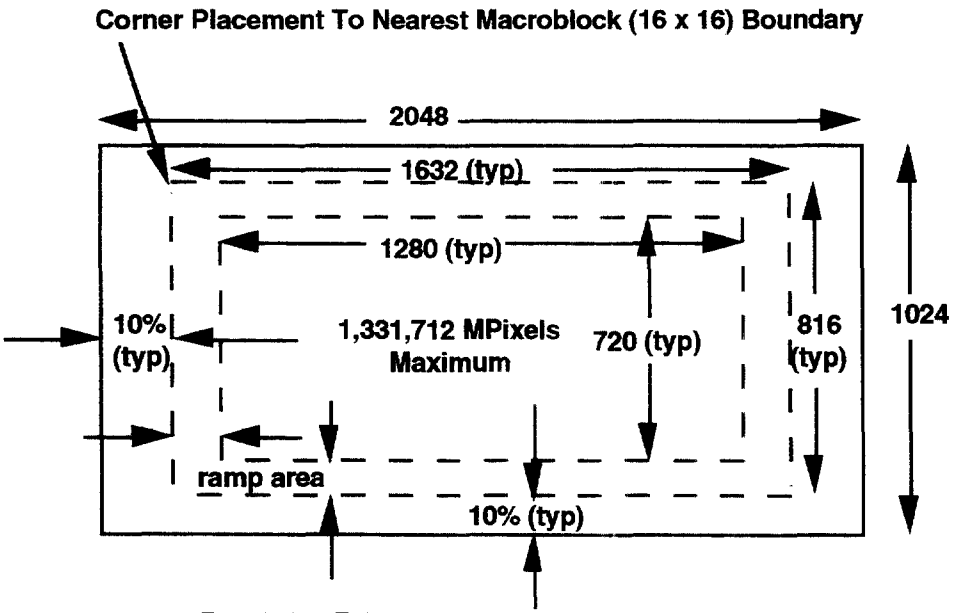
Horizontal: 1632 (typical) within 2048 placed to the nearest 16 x 16 macroblock boundary
Vertical: 816 (typical) within 1024
Maximum Total Resolution: 1,331,712 MPixels (5202 16x16 Macroblocks)

Enhancement layer may have any resolution up to a maximum of 1,331,712 MPixels, but the horizontal and vertical resolutions must be multiples of 16.

Location (corner placement) of 1632 x 816 (typ.) enhancement may change to any 16 x 16 boundary at each "I" frame, but must remain constant between "I" frames. The resolution of the enhancement layer, up to a maximum of 1,331,712 MPixels, may change at each "I" frame, but must remain constant between "I" frames. It is suggested that 1440 x 720, 1536 x 768, and 1632 x 816 be the primary Mode 1 enhancement resolutions which are utilized for the 2.0 : 1 aspect ratio.

1632 x 816 (typ.) format is center weighted. Suggested full amplitude portion is approximately the center 1280 x 720 (typ.) within the 1632 x 816 (typ.) Any ramp may be used, but linear is typical.

Resolution Enhancement Mode 1 is shown diagramatically as follows:

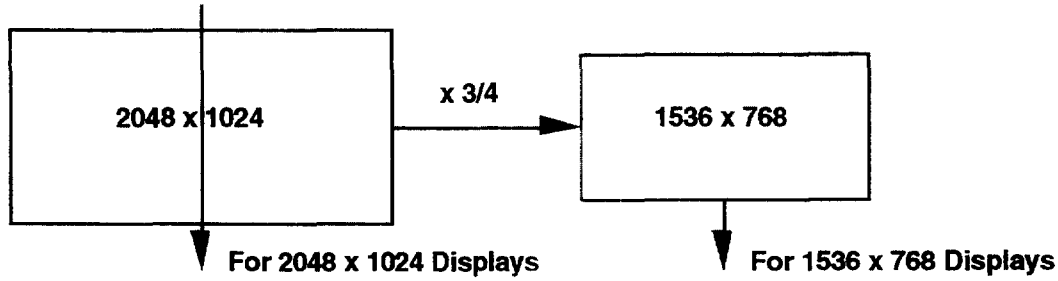


Resolution Enhancement Mode 1

Coding:

Rate	B-Frames	Base Layer Bit Rate	Enhancement Layer	Total (typ.)
24 fps	B Frames Prohibited	4mbps (typ.)	4mbps (typ.)	8mbps
36 fps	B Frames Prohibited	6mbps (typ.)	7mbps (typ.)	13mbps
72 fps	B Frames Required	9mbps (typ.)	9.5mbps (typ.)	18.5mb

Base Layer Expansion Factor: 2
Resulting Resolution: 2048 x 1024



Configurations for aspect ratios other than 2.0 : 1

Resolution Enhancement Mode 1 allows any vertical and horizontal size which are multiples of 16 pixels. The aspect ratio of the enhancement image need not be the same as the aspect ratio of the final image. The enhancement rec tangle can be positioned and shaped to optimize its enhancing benefit in the resulting image. However, it will be typical for the enhancement image to have an aspect ratio similar to the resulting image. For images which do not inherently have a 2.0 : 1 aspect ratio, the aspect ratio of the enhancement image would normally follow the inherent final aspect ratio. Although the unenhanced border percentage will vary since enhancement image placement can be anywhere within the image (to the nearest 16 x 16 boundary), the typical average border area can be shown as follows:

Aspect Ratio	Final Resolution (within 2048 x 1024)	Enhancement Resolution (Typical)	Average Border (Each Edge)
2.37 : 1	2048 x 864	1760 x 752	7%
2.0 : 1	2048 x 1024	1632 x 816	10%
1.85 : 1	1888 x 1024	1568 x 848	8.5%
1.78 : 1	1792 x 1024	1520 x 864	8%
1.37 : 1	1408 x 1024	1344 x 976	2.2%
1.33 : 1	1360 x 1024	1328 x 992	1.6%

Note that the 1,331,712 MPixel limit is the maximum enhancement layer resolution. Lower resolutions than those shown for the enhancement layer may provide good results in many circumstances, while improving coding efficiency. In such cases, the border areas will increase. The center weighting parameters can also effect coding efficiency and image enhancement quality. These parameters can also be optimized. However, a 12% ramp-up region on each edge within the enhancement resolution may be typical

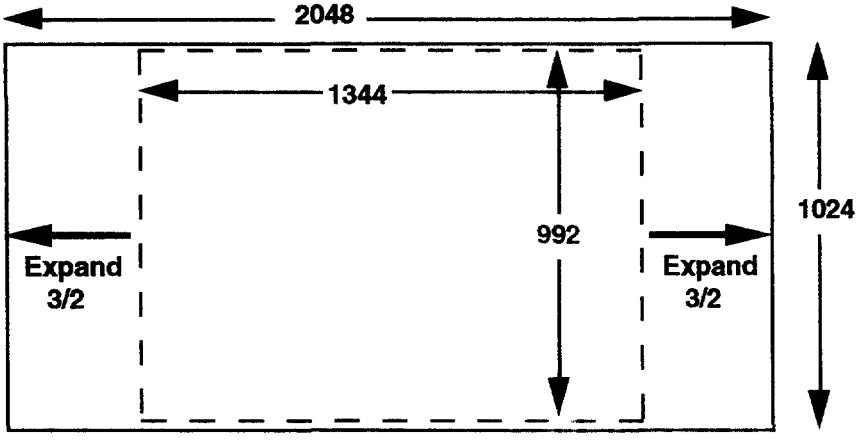
Resolution Enhancement Mode 1 will often provide more optimal coding efficiency than Modes 2, 3, or 4 for many common aspect ratios.

Resolution Enhancement Mode 2:

Horizontal: 1344
Vertical: 992

Location (corner placement) of 1344 x 992 enhancement layer is determined by expanding the 1344 horizontal resolution by 3/2 to 2016, and placing the enhancement layer exactly 16 pixels from the left and right edges. The 992 vertical resolution is placed exactly 16 pixels from the top and bottom edges.

Resolution Enhancement Mode 2 is shown diagramatically as follows:



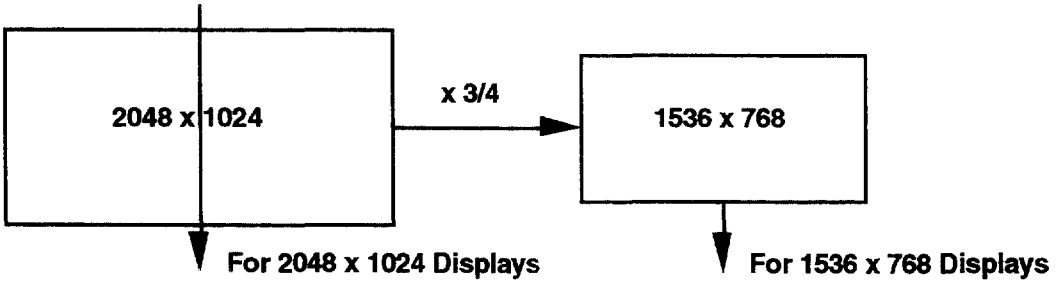
Resolution Enhancement Mode 2

Coding:

Rate	B-Frames	Base Layer Bit Rate	Enhancement Layer	Total (typ.)
24 fps	B Frames Prohibited	4mbps (typ.)	4mbps (typ.)	8mbps
36 fps	B Frames Prohibited	6mbps (typ.)	7mbps (typ.)	13mbps
72 fps	B Frames Required	9mbps (typ.)	9.5mbps (typ.)	18.5mb

Base Layer Expansion Factor: 2

Resulting Resolution: 2048 x 1024

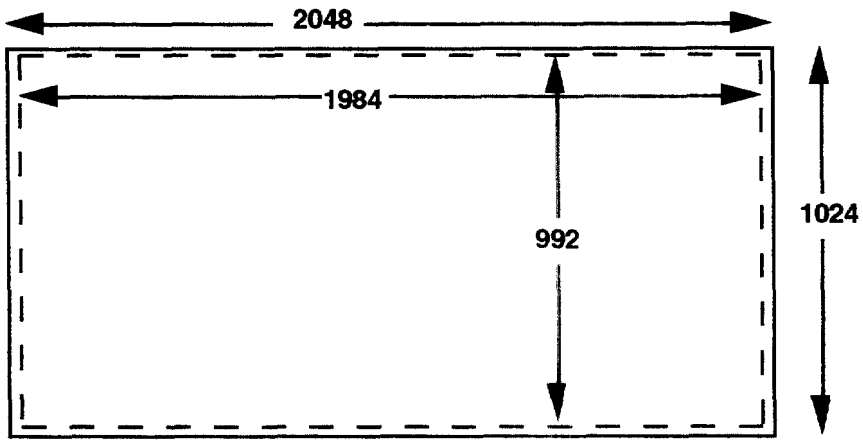


Resolution Enhancement Mode 3:

Horizontal: 1984
Vertical: 992

Location (corner placement) of 1984 x 992 enhancement layer is placed exactly 32 pixels from the left and right edges. The 992 vertical resolution is placed exactly 16 pixels from the top and bottom edges.

Resolution Enhancement Mode 3 is shown diagramatically as follows:



Resolution Enhancement Mode 3

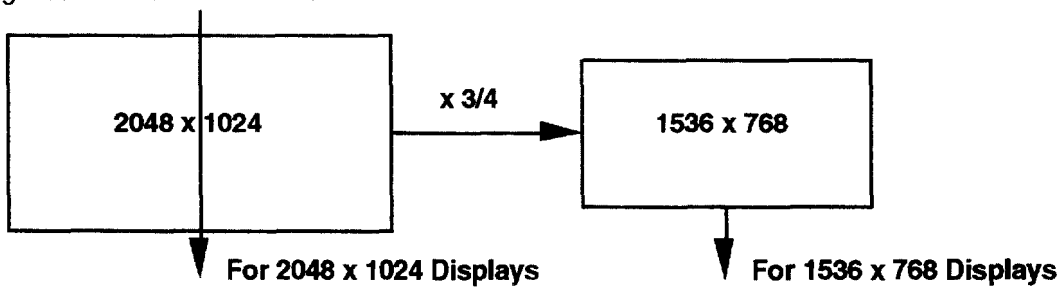
Coding:

Rate	B-Frames	Base Layer Bit Rate	Enhancement Layer	Total (typ.)
24 fps	B Frames Prohibited	4mbps (typ.)	8mbps (typ.)	12mbps

Resolution Enhancement Mode 3 is only supported for 24 fps material (e.g. film). The extra resolution memory is made available by the prohibition on "B" frames.

Base Layer Expansion Factor: 2

Resulting Resolution: 2048 x 1024

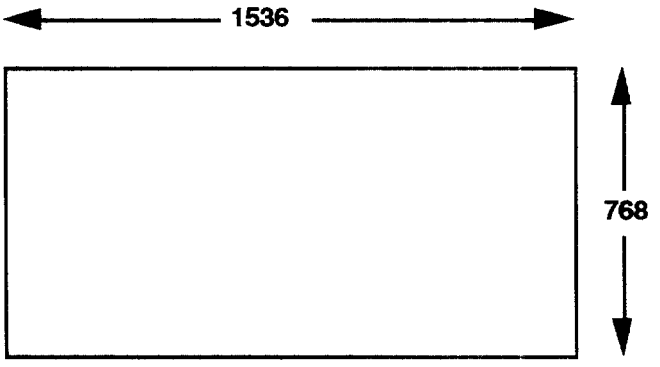


Resolution Enhancement Mode 4:

Horizontal: 1536
Vertical: 768

The 1536 x 768 enhancement layer is placed on top of the resulting 1536 x 768 display.

Resolution Enhancement Mode 4 is shown diagramatically as follows:



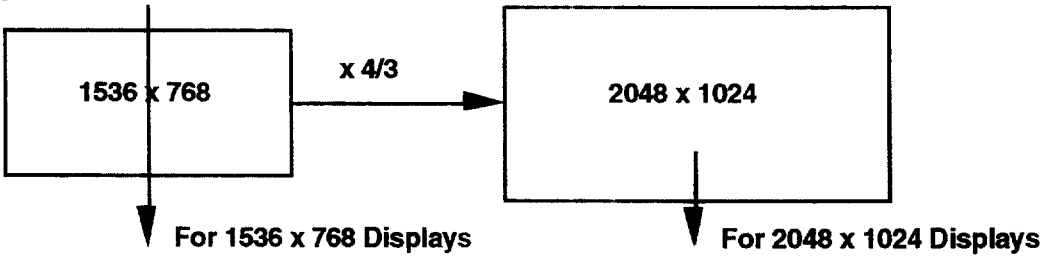
Resolution Enhancement Mode 4

Coding:

Rate	B-Frames	Base Layer Bit Rate	Enhancement Layer	Total (typ.)
24 fps	B Frames Prohibited	4mbps (typ.)	4mbps (typ.)	8mbps
36 fps	B Frames Prohibited	6mbps (typ.)	7mbps (typ.)	13mbps
72 fps	B Frames Required	9mbps (typ.)	9.5mbps (typ.)	18.5mb

Base Layer Expansion Factor: 3/2

Resulting Resolution: 1536 x 768



Base Layer Temporal Enhancement:

Required Decoder Buffers: One additional decoder buffer is used for B Frames

Decoder Memory: 3/4 MByte
(3/2 byte per pixel, times one buffer, times 1/2 MPixel, or 3/4 MByte)

Total Decoder Memory (Base Plus Temporal Enhancement To Base Resolution):
2.25MBytes (1.5 MByes + 3/4 MByte)

Resolution Enhancement:

(Optimized For Movies)

Required Decoder Buffers: Two buffers are used for P and I frame decoding and prediction

Resolution Enhancement Modes 1, 2, and 4,

Decoder Buffer Size: Each decoder buffer is 1.277 MPixel at 3/2 byte per pixel
Times 3 Buffers (May Use B Frames) = 5.75 MBytes

or

Resolution Enhancement Mode 3,

Decoder Buffer Size: Each decoder buffer is 1.916 MPixel at 3/2 byte per pixel
Times 2 buffers (No B Frames) = 5.75 MBytes

Thus, for all resolution enhancement, 5.75 MBytes is required

Total Decoder Memory For Full HDTV (Base Plus Resolution Enhancement):
8.0 MBytes (1.5 MBytes 0.75 MBytes + 5.75 MByte)
(Base Layer + Base Layer B Frames + Resolution Enhancement Layer)

Bit Rate Allocation Of All Bits To Base Resolution Layer

On any frame, all bits may be moved from the resolution enhancement layer into the base resolution layer. All subsequent bits are allocated to the base resolution layer until the subsequent "I" frame, at which time the enhancement layer may be resumed.

This would be done when highly stressful material yields a better coding result when all bits are applied to the base layer, thus terminating the enhancement layer until the next "I" frame. This technique may be used with all four resolution enhancement modes.

Filter Re-Sizing Requirements:

Base Layer Upconversion Filter: 2:1 expansion for Resolution Enhancement Modes 1 - 3
3:2 expansion for Resolution Enhancement Mode 4

For 2048 x 1024 Format and Related Alternate Aspect Ratio Displays:
Image Resizing Filter: 4:3 expansion for Resolution Enhancement Mode 4

For 1536 x 768 Format and Related Alternate Aspect Ratio Displays:
Image Resizing Filter: 3:4 reduction for Resolution Enhancement Modes 1 - 3

Colorimetry, Dynamic Range, and Transfer Function:

Colorimetry, Dynamic Range, and Transfer Function Match Base Layer

Display:

Display Minimum Horizontal Resolution:	1280
Display Maximum Horizontal Resolution:	up to 2048 (optional)
Display Minimum Vertical Resolution:	960
Display Maximum Vertical Resolution:	up to 1024 (optional)
Overlay Planes Minimum:	8
Overlay Planes Maximum:	24

Display Devices Requiring Buffering:

Display Frame Rate Restriction:	72 Hz
Display Buffering:	The display memory is double buffered
Display Buffer Size:	Display buffer size is determined by the format (e.g. RGB vs YUV), the display resolution (minimum 1280 x 960, maximum 2048 x 1024), and the double buffer requirement. Overlay plane memory is also a requirement, with 1 to 3 bytes per pixel.

Optimal Quality Enhanced Resolution Layer Display

Display Resolution 1:

Horizontal:	2048
Vertical:	1024

Two buffers of RGB, for a total of 6 Bytes/Pixel

Total Base Layer RGB Double-Buffer Memory:	12,582,912 Bytes (12MBytes)

16 Bits Overlay Plane

Total Overlay Plane Memory:	4,194,304 Bytes (4MByte)
Total Display Memory:	16,777,216 Bytes (16MBytes)

Display Resolution 2:

Horizontal:	1536
Vertical:	768
Two buffers of RGB, for a total of 6 Bytes/Pixel	
Total Base Layer RGB Double-Buffer Memory:	7,077,888 Bytes (6.8MBytes)
8 Bits Overlay Plane	
Total Overlay Plane Memory:	1,179,648 Bytes (1.1MByte)
Unused:	131,072 Bytes (128KByte)
Total Display Memory:	8,388,608 Bytes (8MBytes)

Display Devices Not Requiring Buffering:

Some display devices do not require buffering. One example is the active matrix liquid crystal (some versions). For such devices which do not require buffering, the display will be updated at the decoded image update rate (24, 36, or72 Hz). No additional buffers would be needed for such devices, except for overlay plane memory, at 1 to 3 bytes per pixel.

Summary Of Base and Enhancement Layer Specifications

Layer	Total Decoder Memory	Maximum Decoder Rate
Base Layer (up to 1024 x 512 at 24 and 36 Hz)	1.5 MBytes	18.9 MPixels/Second (no B Frames)
Base + Temporal Enhancement (up to 1024 x 512 at 72 Hz)	2.25 MBytes	36.8 MPixels/Second (with B Frames)
Base +Resolution Enhancement (up to 2048 x 1024 at 24 and 36 Hz)	8 MBytes	64.0 MPixels/Second (no B Frames)
Base + Temporal +Resolution Enh. (up to 2048 x 1024 at 72 Hz)	8 MBytes	128.0 MPixels/Second (with B Frames)

Displays requiring buffering:

Display Resolution	Required Total Display Memory	Total Including Decoder
2048 x 1024 (with 16 overlay planes)	16 MBytes	24 MBytes
1536 x 768 (with 8 overlay planes)	8 MBytes	16 MBytes
1024 x 512 (with 16 overlay planes)	4 MBytes	6.25 MBytes
640 x 480 (with 8 overlay planes)	2.5 MBytes	4 MBytes

Displays not requiring buffering:

Display Resolution	Required Total Display Memory	Total Including Decoder
2048 x 1024 (16 overlay planes only) (8 MBytes Decoder + 4 MBytes Overlay Memory)	4 MBytes	12 MBytes
1536 x 768 (8 overlay planes only) (8 MBytes Decoder + 2 MBytes Overlay Memory Would Support Up to 12 overlay planes)	1.2 MBytes	9.2 MBytes

Minimum Required To Make A Picture	Total Required Memory	Max. Decoder Rate
Base Layer, Displayed at 640 x 480 (includes 8 overlay planes)	4 MBytes	18.9 MPixels/Second (no B Frames)

System Features:

- Resolution Layering
- Temporal Layering
- 72 Hz display
- No Interlace
- 3-2 Pulldown Eliminated For 24 fps Film
- Up to 2 MPixel Resolution at 72 Hz Without Interlace In 18.5 mbits/sec.
- Low-Cost NTSC Backward Compatibility Via 24 fps and 36 fps Temporal Base Layer

Comparison With ACATS Proposal

ACATS Format	Required Decoder Memory	Maximum Decoder Rate
640 x 480 @60i, 30p	1.4 MBytes	9.2 MPixels/Second (with B Frames)
640 x 480 @60p	1.4 MBytes	18.4 MPixels/Second (with B Frames)
704 x 480 @60i, 30p	1.5 MBytes	10.1 MPixels/Second (with B Frames)
704 x 480 @60p	1.5 MBytes	20.3 MPixels/Second (with B Frames)
1280 x 720 @ 60p	4.2 MBytes	55.3 MPixels/Second (with B Frames)
1920 x 1080 @ 60i, 30p	8.9 MBytes	62.2 MPixels/Second (with B Frames)
Requirement to Decode All Formats (including 1920 x 1080 @ 60i, 30p)		
	8.9 MBytes	62.2 Mpixels/Second (with B Frames)

Displays requiring buffering:

ACATS Display Resolution	Required Total Display Memory	Total With Decoder
640 x 480 (no overlay planes provided)	2.7 MBytes	12 MBytes
1280 x 720 (no overlay planes provided)	8 MBytes	17 MBytes
1920 x 1080 (no overlay planes provided)	18 MBytes	27 MBytes

Minimum Required To Make A Picture[49]	Total Required Memory	Max. Decoder Rate
Display at 640 x 480	12 MBytes	62.2 MPixels/Second
(Up To 1920 x 1080 @ 60i, 30p received ACATS formats)		(with B Frames)

System Features/Problems:

Many Formats, No Layering
Many Frame Rates, No Layering
No Overlay Planes
Includes Interlaced Formats, Requiring De-Interlacer (additional cost)
Requires 3-2 Pulldown For 24 fps Film
Up to 2 MPixel Resolution at 60 Hz Using Interlace In 19 mbits/sec.
NTSC Decoders For Backward Compatibility Require Full HDTV Decoder Performance

[49] The Hitachi "All Formats Decoder" proposal suggests that a lower memory and processing requirement can be used if partial decoding is performed on the MPEG-2 data. However, forward-predictive coding, which is the main compression efficiency tool within MPEG-2, rapidly yields objectionable diverging picture errors with the Hitachi approach. The comparison here is based upon correct decoding of the ACATS formats

Feature	ACATS System	DemoGraFX Layered MPEG-2
Minimum Memory To Make A Correct Picture	12 MBytes	4 MBytes
Minimum Decoder Rate To Make A Correct Picture	62.2 MPixels/Sec (Requires B Frames[50])	18.88 MPixels/Sec (No B Frames[51])
Overlay Planes	Not Provided	8 to 24 Planes
Highest Quality HDTV	1920 x 1080 @ 60i, 30p	2048 x 1024 @72p
Memory For Highest Quality (Assumes Display Requiring Buffering)	27 MBytes	24 MBytes
Decoder Rate For Highest Equivalent Quality Formats	62.2 MPixels/Second For 1920 x 1080 @60i, 30p	64 MPixels/Second For 2048 x 1024 @ 36p
Decoder Rate For ACATS Ultimate Goal vs. DemoGraFX Highest ATV System Capability	124.4 MPixels/Second For 1920 x 1080 @ 60p	128 MPixels/Second For 2048 x 1024 @72p
The DemoGraFX Layered MPEG-2 system already achieves performance exceeding the ACATS stated ulitmate performance goal. The ACATS "Migration Strategy" concept proposes to "migrate" after many years to a goal which is already surpassed by the DemoGraFX system.		

Comparison Of Major Attributes Of DemoGraFX Layered MPEG-2 vs. ACATS

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[50] Note that the requirement to decode "B" frames greatly increases the work of the decoder and it increases the decoder memory bandwidth. By making "B" frame decoding an optional feature, used in enhancement layers, DemoGraFX has made the burdens and benefits of "B" frames be optional for higher-end decoders.

[51] The DemoGraFX base layer decoder is simplified by not only the removal of "B" frames, but also because interlace and 3-2 pulldown are not utilized. These simplifications more than make up for the increase from the 10 MPixels/second of Main Profile @ Main Level (MP @ ML) to 18.88 Mpixels/second, making the DemoGraFX base layer decoder approximately equivalent in cost and complexity.